p-ISSN 2355-5343
e-ISSN 2502-4795
http://ejournal.upi.edu/index.php/mimbar

Article Received: 22/03/2022; Accepted: 27/12/2022
Mimbar Sekolah Dasar, Vol.10(1), 1-14
DOI: 10.53400/mimbar-sd.v10i1.45136

The Effect of Out-of-School Learning Environments on Grade 6 Students' Interest Levels for STEM Professions

Selda Topal[1] & S. Deniz Korkmaz✉[2]

[1] Afyonkarahisar Dumlupınar Science and Arts Education Center, Afyonkarahisar, Turkey
[2] Department of Mathematics and Science Education, Eskişehir Osmangazi University, Eskişehir, Turkey

✉ sduysal@ogu.edu.tr

Abstract. Students should be provided with more meaningful learning experiences to attract more students to STEM careers, Out-of-School learning environments can offer students exciting and motivating learning opportunities that formal environments cannot provide. Therefore, national education reforms in many countries that are working on popularizing STEM career have shifted STEM education to out-of-School learning environments. In this study which used a quasi-experimental design with pretest-posttest control group, the effect of out-of-School learning environments on middle school 6th grade students' interest in STEM field has been investigated. The participants of the research consisted of 14 girls and 22 boys in total 36 students. Within the scope of the research, a STEM education program consisting of 6 different learning environments, four of which is out of school and two in school, has been prepared. The training program of the study was completed in 16 weeks. In the research, the pretest-posttest control group research model was used, and the data were collected using the STEM career interest scale. The results obtained from this study show that non-formal education in out-of-School learning environments is effective in the orientation of secondary school students to STEM career fields especially Science related professions.

Keywords: Career Interest, Out-of-School Learning Environments, Non-formal Education, STEM.

1. Introduction

One of the most important decisions that a person makes in his life is the choice of profession or career. According to Super (1984), career interest or desire for a particular career is a learned trait (cited by Koszalka, 1999). Considering learning career interest increases academic success and enthusiasm, it should be created at a young age. Individuals should first have information about the professions and then decide on their profession in line with their interests, expectations and competencies. For this reason, appropriate environments should be provided for individuals to wonder and question their profession and business world during secondary education (Muro&Kottman,1995). In developed countries, where students are subject to effective guidance starting from small classes, it is argued that qualified students who are preparing to start their STEM careers and who are interested in STEM careers should be increased in order to maintain their competitiveness in the global economy (Carnevale, Smith, & Melton,2011).

However, a study by the American Association of Quality (ASQ) found that more than 85% of students today are not considering a career in engineering (PCAST, 2010). In the USA, which is the origin country of the STEM approach, it has been tried to provide students with the motivation to develop their careers, especially in the STEM fields of study. (NAE and NRC, 2009; NGGS, 2013); NRC, 2012; PCAST, 2010). Likewise in Europe and Australia has been seen a need to popularize STEM education to raise students' awareness of these fields and attention was drawn to the need for giving greater weight to STEM education because engineering and mathematics are not preferred as much by the younger generation. The situation is similar in Turkey, that is, employment and career rates for STEM fields are quite low. The statistical data of the Turkish Higher Education Council (YÖK) show that only 13% of the students admitted to universities in Turkey in 2014-2015 preferred study areas of STEM (Altan et al., 2019).

1.1. Problem Statement

Presenting STEM careers at an early age will encourage many talented students to aim for careers in these professions and to take required science and math courses in high school (DeBacker & Nelson, 1999, Dejarnette, 2012, Kier et al., 2013, Maltese & Tai, 2011, Murphy & Beggs, 2005; Tai et al., 2006, Super, 1984). When STEM fields are part of the primary education curriculum, students become more aware of the different possibilities for engineering, science and careers. Thus, they will be more likely to see these careers as options to choose from. This possibility is important at a time when the number of university students who continue their engineering and basic science education is decreasing.

To attract more students to STEM careers, students should be provided with more meaningful learning experiences by motivating them with learning experiences that are directly relevant to the world they live in (Chittum & Jones, 2017; Cutucache, Luhr, Nelson, Grandgenett, &Tapprich, 2016; Schnittka, Evans, Won, & Drape, 2015). Out-of-school learning environments can offer students exciting and motivating learning opportunities that formal environments cannot provide. Therefore, national education reforms in many countries that are working on popularizing Science, Technology, Engineering and Mathematics (STEM) education based on the integration of disciplines have shifted STEM education to out-of-school learning environments. (National Research Council, 2012; 2015; STEM Education Coalition, 2016, Feder & Jolly, 2017).

1.2. Related Research

Although there are studies on the use of non-formal learning environments outside the school and/or classroom as an educational environment (Dierking, Falk, Rennie, Anderson, & Ellenbogen, 2003), the number of studies investigating the effect of career choice, especially STEM career is quite limited.

1.3. Research Objectives

This study aims to research the effect of out-of-school learning environments on secondary school students' career choice in orienting them to STEM careers. For this purpose, in out-of-school learning environments, students were provided with career recognition and knowledge, and it was investigated how being in these environments affected the 6th grade students' interest in STEM professions in their career choice. In this context, the following sub-problems were examined:

1. Is there a significant difference between the levels of interest in STEM-related professions of the experimental group participating in out-of-school learning environments before and after the research?
2. Is there a significant difference between the levels of interest in STEM-related professions of the control group students who continue the educational activities stipulated by the science course curriculum before and after the research?
3. What is the effect of the STEM activities on students’ interest levels of STEM-related professions?

2. Theoretical Framework

Occupations are a field of activity that not only creates the most important source of status for a person's social identity, but also provides the opportunity for a person to receive respect from the environment, to have a place in society and to feel useful. (Kuzgun, 2003). On the other hand, profession is not only a method of earning money and a livelihood, but also a method of self-expression and self-realization. Therefore, the choice of profession is the planning of a future in which the individual can be happy.

In recent years, a study on career identity development including many countries shows that the strongest determinant of career identity is career interest, and interventions made at an early age open the horizons of children and raise their career goals (Chambers et al., 2018). Considering learning career interest increases academic success and enthusiasm, it should be created at a young age. For this purpose, developed countries are subjecting students to effective guidance starting from the 4th and 5th grades in line with their interests and skills in educational institutions in order to restructure their education models in line with the needs of the current period, to train the qualified manpower needed by the industry and to use the manpower in the most effective way. In developed countries, where students are subject to effective guidance starting from small classes, it is argued that qualified students who are preparing to start their STEM careers and who are interested in STEM careers should be increased in order to maintain their competitiveness in the global economy (Carnevale, A.P., Smith, N., & Melton, M., 2011). However, a study by the American Association of Quality (ASQ) found that more than 85% of students today are not considering a career in engineering (PCAST, 2010). Similarly, it was indicated that more emphasis should stand on STEM education in order for the younger generation to show more interest in STEM fields in Europe, and it was also noted that this education has become a necessity (Business Europe, 2011, Aydeniz & Bilican, 2017).

In Turkey, students usually make their profession or career choices according to the year they will take the exam for higher education and/or the score they get in the selection exams. Even in students who are considered adults in terms of their age at the time they enter the selection exams, there are situations such as indecision in their career choices, not being able to make any decisions or being dissatisfied with the decision they have made. On the other hand, as there are studies in the literature showing that the employment and career rates of students in STEM fields are quite low (Kızılay, 2018), the statistical data of the Turkish Higher Education Council (YÖK) show that only 13% of the students admitted to universities in Turkey in 2014-2015 preferred study areas of STEM (Altan et al., 2019).

Presenting STEM careers at an early age will encourage many talented students to aim for careers in these professions and to take required science and math courses in high school. To attract more students to STEM careers, students should be provided with more meaningful learning experiences by motivating them with learning experiences that are directly relevant to the world they live in. Active learning experiences are essential to enable students to explore new and emerging technologies that offer opportunities and apply their knowledge, skills and creativity to solving real problems in the real world (Camp, Broyles, & Skelton 2002). The teaching approach in which the students takes an active role in learning, learn by doing and experiencing, connect what they learn with what they see around them, has been adopted by many countries. One of the most effective methods of this understanding is learning outside the school/classroom. Out-of-school learning environments can offer students exciting and motivating learning opportunities that formal environments cannot provide, as well as in areas such as company visits, museums, technology fairs, picnic areas or historical sites, students will be able to find a learning environment by seeing, experimenting and questioning the information about the subject. Therefore, national education reforms in many countries that are working on popularizing Science, Technology, Engineering and Mathematics (STEM) education based on the integration of disciplines have shifted STEM education to out-of-school learning environments. (National Research Council, 2012; 2015; STEM Education Coalition, 2016, Feder & Jolly, 2017). Although there are studies on the use of non-formal learning environments outside the school and/or classroom as an educational environment (Dierking, Falk, Rennie, Anderson, & Ellenbogen, 2003), the number of studies investigating the effect of career choice, especially STEM career is quite limited. For this reason, in this study, the effects of school and/or out-of-school learning environments on students' interest levels in STEM careers were investigated.

3. Method

3.1. Research Design

This study uses the pre-test-post-test control group research model with quantitative approach which is widely used in the field of educational science. The pre-test-post-test control group design is a quasi-experimental design in which participants are randomly assigned to either a training (the experimental group) or not (the control group)(Creswell, 2003). Experimental designs are studies that are conducted under the control of the researcher and that necessarily include a comparison. This can be a comparison of a certain group within itself or a comparison between two different groups. The individuals in the experimental group also form the application group and are subjected to different trainings on the topic in addition to their current training. Individuals in the control group either continue to pursue their current education or lifestyle. At the end of the study, the changes in the characteristics of the individuals in the experimental and control groups, which are the subject of the study, are compared (Büyüköztürk, 2007). In the study, an experiment and a control group were selected to test the effect of out-of-school learning environments on Interest Levels for STEM Professions. The individuals in the experimental group consisted of students who received non-formal education out-of-school in addition to the education they received at school, and the students in the control group consisted of students who participated in the formal education program without participating in the non-formal education. In the study, which took 16 weeks, the experimental group students were provided to participate in 4 different out-of-school learning environments and receive 2 different non-formal education in school, while only the STEM activities stipulated by the curriculum (MoNE, 2018) were carried out with the control group students.

3.2. Participant/Respondent

The study group of the research consisted of 6th grade students studying in a public school in Afyonkarahisar province, in the 2019-2020 academic year. Information on the demographic characteristics of the students in the study group consisting of 14 girls and 22 boys in total 36 students is presented in Table 1.

Table 1. Gender Frequency and Percentage Distributions of Students in the Experimental and Control Groups

Factor	Sub-Factor	Experimental group		Control group	
		f	%	f	%
Gender	Girl	8	44.4	6	33.3
	Boy	10	55.6	12	66.7

The determination of the experimental and control groups in the research was carried out by random method. For this purpose, lots were drawn among the 6th graders in the secondary school where one of the researchers was working. Thus, one of the classes with 18 students each was determined as the control group and the other as the experimental group. Participants of this study are the children of families with low socioeconomic because it has been determined that the probability of the children of families with low socioeconomic status to be successful in STEM fields is lower than the children of families with high socioeconomic status (OECD, 2007), and accordingly, they are less likely to be in STEM professions (Gorard & See, 2009).

The necessary legal permissions and parent consent forms were collected by the researchers in order for the students in the study group to participate in the field trips and trainings during the research. Therefore, the students in the experimental group of the study did not experience any problems in terms of transportation and getting permission during the trip, and they participated in all the trips and activities carried out during the research process.

3.3. Data Collection

"Science, Technology, Engineering and Mathematics Career Interest Scale (STEM-CIS)" which was developed by Kier et al. (2014), and adapted to Turkish by Koyunlu-Unlu et al. (2016) was used in determination of 36 students' attitude towards STEM professions who were in the study group of the research. The Turkish-adapted form of the STEM Career Interest Scale consists of 40 items. The scale has science, technology, engineering and mathematics sub-dimensions. Each sub-dimension includes 10 items. The scale is based on Bandura's social cognitive learning theory. For each item of the scale, which was allowed to apply before starting the study, students were asked to choose the most appropriate option among the following options: "I Don't Agree Definitely," "I Don't Agree," "I'm Indecisive," "I Agree," and "I Agree Definitely". The options "I Agree Definitely," "I Don't Agree," "I'm Indecisive," "I Agree," and "I Don't Agree Definitely" are determined respectively as 1 point, 2 points, 3 points, 4 points and 5 points. Negative expressions are coded in a reverse order.

3.4. Validity and Reliability

In the Turkish validity and reliability study of the 5-point Likert-type STEM Career Interest Scale, the internal consistency coefficients of the scale sub-dimensions were given as .88 in science, .87 in mathematics, .88 in technology and .90 in engineering. It was stated that the general internal consistency coefficient of the scale was .94. (Koyunlu-Unlu et al., 2016).

3.4. Data Analysis

The data collected in the study were analyzed using the SPPS 22.0 statistical package program. Before the scale scores of the students participating in the study were compared between the pre-test and the post-test, whether the data were suitable for normal distribution was examined using the Shapiro-Wilk test and skewness - kurtosis values.

Assumptions of normality and homogeneity of variances were checked and met before analyzing to check the effect of STEM activities on students' STEM-related professons scores. When Table 2 is examined, it is seen that the data of Interest in Science-Related Professions post-test, Interest in Mathematics-Related Professions pre-test and Interest in Technology-Related Professions do not follow the normal distribution according to the Shapiro-Wilk test ($p<0.05$), while the other data comply with the normal distribution. On the other hand, according to the skewness – kurtosis values in the range of -2 and +2, it can be accepted that all data fit the normal distribution.

Table 2. Shapiro-Wilk Test of Normality and Skewness – Kurtosis Values

Scale / sub-dimension	Test	Shapiro-Wilk Test value	p	Skewness	Kurtosis
The Interest in Science	Pre test	.959	.207	.633	.505
Related Profession	Post test	.908	.006	1.346	1.249
The Interest in Technology	Pre test	.932	.029	.828	1.406
Related Professions	Post test	.955	.155	.425	-.390
The Interest in Engineering	Pre test	.963	.271	.447	-.434
Related Professions	Post test	.958	.191	.568	.195
The Interest in Mathematics	Pre test	.933	.032	.857	.299
Related Professions	Post test	.966	.335	.524	-.050

In the process of evaluating the scores obtained from STEM-CIS; the dependent groups t-test was used to compare the pre-test-post-test scores of the experimental and control groups in themselves, and the significance level was taken as 0.05.

3.5. Out of School Learning Environments and Non-formal Education

In the experimental and control groups, the lessons were conducted by the lesson teacher, who was also one of the researchers. Within the scope of the research, non-formal trainings given to the experimental group students. Non-formal education defined as planned, structured programs and processes of personal and social education for young people designed to improve a range of skills and competences, outside the formal educational curriculum (Coombs, 1976). Some features of non-formal education can be summed up as follows:

- accessible to everyone

- participatory
- learner-centred
- an organised process with educational objective
- organised on the basis of the needs of the participants.
- based on involving both individual and group learning with a collective approach.

In this research, non-formal trainings which have the features above has been designed with a content planned in line with the goals of STEM education. Experimental group students were provided with non-formal training in and out-of-school, STEM activities stipulated by the curriculum were carried out in the classroom, and the teaching activities prescribed by the curriculum were carried out with the control group students. Non-formal trainings which were also planned considering the socioeconomic level of the school, are listed below:

- "Architecture and Future Professions"

  The presentation of Assistant Professor Türkan Nihan Hacıömeroğlu from Eskisehir Osmangazi University/The Faculty of Architecture and Engineering who was invited within the scope of Scientific and Technological Research Council of Turkey (TUBITAK) science talks,

- University Trip
  Afyonkarahisar Kocatepe University Faculty of Technology trip,
- "Science With Deep Space Missions"
  Webinar with Dr. Umut YILDIZ, who works at NASA,
- Coding and Robotics
  By making an appointment with Afyonkarahisar Dumlupınar Science and Arts Education Center for gifted student (BILSEM), listening to the coding and robotics presentation from the experimental group BILSEM technology design teacher Savaş Özbey and IT teacher Hidayet Kılcan, examining and applying the robotic sets there.
- Public Institution Trip
  A trip to Afyonkarahisar province wastewater treatment plant,
- STEM activities outside the classroom
  These are the activities carried out outside the classroom through the STEM club. In this context, students divided into groups,

1. edible vehicles were designed with the fruits and vegetables students brought from their homes, and the vehicles designed by the student groups were competed.

Figure 1. Example of STEM activity outside the classroom.

2. the parachutes designed by the student groups and the criteria for completing the given task of the parachutes designed by the student groups were evaluated by the jury formed by the school-teachers.

Before the non-formal education started, the "Science, Technology, Engineering and Mathematics Career Interest Scale" was applied to both the experimental and control groups as a pre-test. After the training was completed, the scale was reapplied to both groups as a post-test and the results were analyzed.

4. Findings

This section includes the findings and comments obtained by evaluating the data collected by the method specified in the previous section, as a result of the statistical analysis, in order to examine the sub-problems of the research. In the study, it was examined whether out-of school learning environments and non-formal education have an effect on the level of interest of 6th grade students towards STEM professions. The findings and comments obtained during the research process were arranged according to the order of the sub-problems of the research.

4.1. Findings Regarding the Levels of Interest in STEM Related Occupation of Experimental group

The data for the first sub-problem, "Is there a significant difference between the levels of interest in STEM-related professions of the experimental group participating in out-of-school learning environments before and after the research?" were analyzed using the dependent groups t-test to determine the differentiation within the group and the results are shown in Table 3.

Table 3. Comparison of Experimental Group Students' Levels of Interest in STEM Related Occupations, Pre-Test and Post-Test Scores (p<0.05)

STEM related Professions	**Tests**	**Mean** $\bar{X}$	**Standard Deviation sd**	**Degree of Freedom Df**	**t statistic**	**Probability value p**
Science-related professions	Pre test-Post test	6.17	4.22	17	6.202	.000*
Technology-related professions	Pre test-Post test	2.61	2.43	17	4.56	.000*
Engineering-related professions	Pre test-Post test	4.11	5.74	17	-3.03	.007*
Mathematics-related professions	Pre test-Post test	3.33	4.37	17	-3.23	.005*
Total STEM-CIS Scores	Pre test-Post test	16.22	11.09	17	6.26	.000*

$p<0.05$

When Table 3 is examined, there is a significant difference between pre and post test scores of experimental group in terms of interest levels of science-related professions ($\bar{X}_{sci\_post}$=26.67, $\bar{X}_{sci\_pre}$=20.50), technology-related professions ($\bar{X}_{tech\_post}$=24.22, $\bar{X}_{tech\_pre}$=21.61), engineering-related professions ($\bar{X}_{eng\_post}$=27.00, $\bar{X}_{eng\_pre}$=22.89), mathematics-related professions ($\bar{X}_{math\_post}$=24.72, $\bar{X}_{math\_pre}$=21.39) and total STEM-CIS Scores ($\bar{X}_{tot\_post}$=102.61 and $\bar{X}_{tot\_pre}$=86.39).

4.2. Findings Regarding the Levels of Interest in STEM Related Occupation of Control Group

The data for the second sub-problem, "Is there a significant difference between the levels of interest in STEM-related professions of the control group students who continue the educational activities stipulated by the science course curriculum before and after the research?" were analyzed using the dependent groups t-test to determine the differentiation within the group and the results are shown in Table 4.

Table 4. Comparison of Control Group Students' Levels of Interest in STEM-CIS Science-Related Occupations, Pre-Test and Post-Test Scores ($p<0.05$)

STEM-retaleted profesions	Tests	Arithmetic mean $\bar{X}$	Standard Deviation sd	Degree of Freedom df	t statistic	Probability value p
Science-related professions	Pre test-Post test	1.22	4.76	17	1.09	.291
Technology-related professions	Pre test-Post test	1.44	6.13	17	1.00	.331
Engineering-related professions	Pre test-Post test	1.33	5.66	17	1.00	.331
Mathematics-related professions	Pre test-Post test	1.67	4.24	17	1.67	.114
Total STEM-CIS Scores	Pre test-PostTest	5.67	17.72	17	1.35	.193

When Table 4 is examined, control group students results were not significantly different ($p>0.05$) in terms of pre and post test scores of science-related professions interest levels ($\bar{X}_{sci\_post}$=23.17, $\bar{X}_{sci\_pre}$=21.94), technology-related professions interest levels ($\bar{X}_{tech\_post}$=24.00, $\bar{X}_{tech\_pre}$=22.56), engineering-related professions interest levels ($\bar{X}_{eng\_post}$=25.72, $\bar{X}_{eng\_pre}$=24.39), mathematics-related professions interest levels ($\bar{X}_{math\_post}$=23.56, $\bar{X}_{math\_pre}$=21.89) and total STEM-CIS Scores ($\bar{X}_{tot\_post}$=96.44, $\bar{X}_{tot\_pre}$=90.78).

4.3. Findings Regarding the effect of out-of school learning environments on the students' levels of interest in STEM-related professions

Independent t-tests were conducted to examine the effect of out-of-school learning environments on the students' levels of interest in STEM-related professions. Gain scores, which were obtained by subtracting post scores from the pretest scores, were used as the dependent variable; and the group was treated as the independent variable.

The data for the second sub-problem, "What is the effect of the STEM activities on students' interest levels of STEM-related professions" were analyzed using the independent groups t-test to determine the differentiation between the groups and the results are shown in Table 5.

Table 5. Independent t-test results for the experimental and control groups' pretest-posttest gain scores ($p<0.05$)

	Group	N	M	SD	t	Df	P
Science	Experimental	18	6.17	4.22	3.30	34	.002*
	Control	18	1.22	4.75			
Technology	Experimental	18	2.61	2.43	0.75	34	.46
	Control	18	1.44	6.12			
Engineering	Experimental	18	4.11	5.74	1.46	34	.15
	Control	18	1.33	5.66			

Mathematics	Experimental	18	3.33	4.37	1.16	34	.25
	Control	18	1.67	4.24			
STEM	Experimental	18	15.22	9.99	2.03	34	.05*
	Control	18	5.44	17.79			

$*p \leq 0.05$

Independent t-test results comparing students' pretest scores for the experimental and control groups indicated that they were similar at the beginning of research, ($t(34) = .56$, $p = .581$.) Independent t-test results for experimental and control groups' posttest-pretest gain scores are presented in Table 5. There was no statistically difference for the technology, engineering and mathematics related professions interest levels. On the other hand, there was a significant difference in science related professions interest with effect size value (η^2=%17). In addition, students' STEM-CIS total scores across both groups were significantly different. Experimental students outperformed the traditional students on the gain scores.

5. Discussion

Out-of-school learning environments are interesting and enable students to connect their learning experiences (NRC, 2015). Therefore, STEM education is being transferred to out-of-school learning environments in many countries (Feder & Jolly, 2017), and STEM activities are recommended to be held in non-formal learning environments such as science centers, museums, botanical gardens or through planned camp programs (STEM Education Coalition, 2016). In this study, non-formal education given in out-of-school learning environments and STEM activities in the classroom provided students with career recognition and knowledge, and it was investigated how being in these environments affected the 6th grade students' interest in STEM professions in their career choice. It was determined that the all students participated in this study had low career awareness scores in STEM fields before attending the program. Especially, the pre-test scores of both control and experimental group students in science were lower than the scores in the other STEM fields. High career awareness scores for the other STEM disciplines except science indicates that these students may already have awareness of careers in these STEM fields. When the pre-test scores of both group students compared, the scores of control group students are higher than the scores of experimental group students for all STEM fields.

When the post-test scores of both group students are compared the increase of career awareness scores of experimental group students were greater than that of control group students. On the other hand, the increase of STEM career awareness scores of experimental group students in the post-test measurements, was greater than that of control group students. The increase of STEM career awareness scores of experimental group students for science in the post-test measurements, was greater than that in the other disciplines. The high increase of career awareness scores for science may be due to the fact that the study was carried out in the science course.

There was a significant difference in the experimental group in the in-group comparisons, but no statistically significant difference was found in the control group. In other words, the career interests of the experimental group students to the STEM disciplines of science, mathematics, technology and engineering increased more than the students in the control group students were applied to the activities in the science lesson curriculum. This result shows that performing only the STEM activities stipulated by the curriculum in science lessons does not cause an increase in students' interest in STEM professions, that is, it is not sufficient to direct them to STEM professions.

The results obtained from this study show that non-formal education in out-of-school learning environments is effective in orienting secondary school students to STEM career interests. In the literature research, it is seen that STEM education and activities given in schools contribute to students' STEM career interests in all sub-dimensions (Batı et al, 2017; Becker & Park, 2011; Carroll, 2014; Christensen & Knezek, 2017; Çevik, 2018; Dökme, 2016; Hansen & Gonzalez, 2014; Hare ,2017; Karakaya et al., 2018; Kızılay, 2018; Ralston et al., 2012; Şahin et al., 2014; Uğraş, 2019). On the other hand, studies carried out in out-of-school environments have shown that being in different environments gives students different perspectives, and activities associated with daily life and carried out in a practical and applied way increase learning and interest in science and engineering (Akay, 2013; Altan et al., 2019; Birinci Konur et al., 2011; Markowitz, 2004; Marulcu, Saylan & Güven, 2014; Sezen Vekli, 2013; Tekbıyık et al., 2013; Yıldırım, Atila & Doğar, 2016). The results of this research are compatible with the literature and show that out-of-school learning environments are effective in students' STEM-related career planning.

Another important result of this study is that there is a dramatically increasing of interest of the students who attended in out-of-school learning environments Science related professions when compared their interest to other STEM related professions. The reason of the result might be this research was executed in the scope of Science lesson as we pointed before.

6. Conclusion

By regarding of the results of this study students can be provided with positive attitudes towards science and mathematics with teaching programs supported by out-of-school learning environments. Students' positive attitudes towards science and mathematics courses can increase their success in these courses, as well as increasing the interest in basic sciences, which constitute the infrastructure of a country's technological development. Supporting the science curriculum with out-of-school learning environments may increase the interest of secondary school students with low socioeconomic status and high academic achievement in vocational and technical high schools. It may be possible to train qualified personnel to supply the need of the industry, by the preference of successful students in such schools, which provide the need for qualified staff to the industry.

Limitation

The research is limited to 4 out-of-school and 2 in-school informal education environments and was conducted with 36 students studying in the 6th grade of a secondary school in Afyonkarahisar province.

Recommendation

According to the results of the study, the following recommendations can be made.

1. Students' interest levels can be examined by diversifying out-of-school/out-of-school learning environments that will support the science, mathematics and the other STEM related curriculum.
2. Comparisons can be made by conducting similar studies with schools in regions with low socioeconomic level and schools located in regions with high socioeconomic level, which have problems in accessing out-of-school learning environments.
3. Studies can be conducted to examine the effects of out-of-school/ out-of-school learning environments on the interest in STEM professions of students studying at different education levels.
4. Studies in which, students' interests in STEM professions were discussed with larger sample groups can be done according to different demographic variables (parents' education level, parents' profession, age group, grade level, gender, academic achievement level, attitude towards science lesson, etc.) in secondary and high school students.
5. By integrating out-of-school/out-of-school learning environments into the curriculum, it can be ensured that students participate in a certain number of activities at every education level, especially in public schools in regions with low socioeconomic levels.

Acknowledgment

This study was presented as an oral presentation in VIII[th] International Eurasian Educational Research Congress. We are grateful to Editor and reviewers for their valuable feedback during the revision process.

Conflict of Interest

The Authors declare that there is no conflict of interest.

References

Akay, C. (2013). Ortaokul öğrencilerinin TÜBİTAK "4004 Yapıyorum Öğreniyorum Yaz Bilim Okulu" projesi sonrası bilim kavramına yönelik görüşleri [The opinions of the secondary school students towards science concept following TUBITAK 4004 "Learning By Doing Summer Science School]. *Mersin University Journal of the Faculty of Education* , 9(2), 326-338. https://dergipark.org.tr/en/download/article-file/160909

Altan, E., Üçüncüoğlu B. & Öztürk, N. (2019). Preparation of out-of-school learning environment based on science, technology, engineering and mathematics education and investigating its effects. *Science Education* International, 30(2), pp. 138-148. https://doi.org/10.33828/sei.v30.i2.7

Aydeniz, M., & Bilican, K. (2017). Global developments in STEM education and implications for Turkey. 3rd ed. In: Çepni, S.,(Ed.), (STEM education from theory to practice). Turkey, Ankara:PegemA Press. 69-190.

Batı, K., Çalışkan, İ. & Yetişir, M. İ. (2017). Fen eğitiminde bilgi işlemsel düşünme ve bütünleştirilmiş alanlar yaklaşımı (STEAM) [Computational thinking and integrative education (steam) in science education], Pamukkale University Journal of Education 41(41):91-103 https://dergipark.org.tr/tr/download/article-file/399550

Becker, K., & Park, K. (2011). Effects of integrative approaches among science, technology, engineering, and mathematics (STEM) subjects on students' learning: A preliminary meta-analysis. *Journal of STEM Education: Innovations & Research*, 12(5-6), 23-37 https://www.jstem.org/jstem/index.php/JSTEM/article/view/1509/1394

Birinci Konur, K., Şeyihoğlu, A., Sezen, G., & Tekbıyık, A. (2011). "Bir bilim kampı uygulamasının değerlendirilmesi: gizemli dünyanın eğlenceli keşfi" [Evaluation of a science camp: enjoyable discovery of mysterious world], *Kuram ve Uygulamada Eğitim Bilimleri*, 11(3), 1589-1608. https://dergipark.org.tr/tr/download/article-file/789133

Business Europe (2011). Plugging the skills gap: The clock is ticking. http://www.businesseurope.eu/Content/Default.asp?pageid=568&docid=28659.

Büyüköztürk, Ş. (2007). Deneysel desenler: öntest-sontest kontrol grubu desen ve veri analizi [Experimental patterns pretest-posttest control group pattern and data analysis] (2nd ed.). Ankara: Pegem A Yayıncılık.

Camp, W. G., Broyles, T. & Skelton N. S. (2002). A national study of the supply and demand for teachers of agricultural education in 1999-2001. http://www.naae.org

Carroll, M. P. (2014). Shoot for the moon! The mentors and the middle schoolers explore the intersection of design thinking and STEM. *Journal of Pre- College Engineering Education Research (J-PEER)*, 4(1), 3. https://doi.org/10.7771/2157-9288.1072

Carnevale, A.P., Smith, N., & Melton, M. (2011). STEM: Science technology engineering mathematics. Washington: Georgetown University Center on Education and the Workforce. https://cew.georgetown.edu/wp-content/uploads/2014/11/stem-complete.pdf

Chambers, N., Kashefpakdel, Elnaz T., Rehill, J. & Percy C. (2018), Exploring the career aspirations of primary school children from around the World: Drawing the future, January 2018, p.74 https://www.educationandemployers.org/research/drawing-the-future/

Chittum, J. R., & Jones, B. D. (2017). Identifying pre-high school students' science class motivation profiles to increase their science identification and persistence. Journal of Educational Psychology. https://doi.org/10.1037/edu0000176

Christensen, R., & Knezek, G. (2017). Relationship of middle school student STEM interest to career intent. *Journal of Education in Science, Environment and Health (JESEH)*, 3(1), 1-13. https://doi.org/10.21891/jeseh.275649

Coombs, P. H. (1976). Non-formal Education: Myths, Realities, and Opportunities. *Comparative Education Review*, *20*(3), 281–293. http://www.jstor.org/stable/1187481

Creswell, J. W. (2003). Research design: Qualitative, quantitative, and mixed methods approaches (2nd ed.). Thousand Oaks, CA: Sage.

Cutucache, C. E., Luhr, J. L., Nelson, K. L., Grandgenett, N. F., & Tapprich, W. E. (2016). NE STEM 4U: An out-of-school time academic program to improve achievement of socioeconomically disadvantaged youth in STEM areas. International Journal of STEM Education, 3(6), 1–7. https://doi.org/10.1186/s40594-016-0037-0

Çevik, M. (2018). Impacts of the project based (PBL) science, technology, engineering and mathematics (STEM) education on academic achievement and career interests of vocational high school students. *Pegem Journal of Education and Instruction,* 8(2), 281 https://doi.org/10.14527/pegegog.2018.012.

DeBacker, TK, & Nelson, RM. (1999). Variations on an expectancy-value model of motivation in science. *Contemporary Educational Psychology*, 24(2), 71-94 https://doi.org/10.1006/ceps.1998.0984.

Dejarnette, N. K. (2012). America's children: Providing early exposure to STEM (science, technology, engineering and math) initiatives. Education, 133(1), 77–84. https://www.afcea.org/event/sites/default/files/files/America's%20Children-%20Providing%20early%20exposure%20to%20STEM.pdf

Dierking, L. D., Falk, J. H., Rennie, L. J., Anderson, D., & Ellenbogen, K. (2003). Policy statement of the "informal science education" Ad Hoc Committee. *Journal of Research in Science Teaching*, 40(2), 108-111. https://doi.org/10.1002/tea.10066

Feder, M.A., & Jolly, E. (2017). *What do we Know About Stem in Out-of- School Setings?* A National Research Council Report. STEM Ready America. https://www.researchgate.net/publication/315855954_What_Do_We_Know_About_STEM_in_Out-of-School_Settings_A_National_Research_Council_Report#fullTextFileContent

Gorard, S., & See, B.H. (2009). The impact of socio-economic status on participation and attainment in science. *Studies in Science Education*, 45(1), 93–129. https://doi.org/10.1080/03057260802681821

Hansen, M., & Gonzalez, T. (2014). Investigating the relationship between STEM learning principles and student achievement in math and science. *American Journal of Education*, 120(2), 139-171. https://doi.org/10.1086/674376

Hare, L. N. (2017). The perceptions of STEM from eighth-grade African-American girls in a high-minority middle school. (Unpublished doctoral thesis). Gardner Webb University. https://core.ac.uk/download/pdf/212811453.pdf

Horzum, M. B. & Balta, Ö. Ç. (2008). Farklı web tabanlı öğretim ortamlarında öğrencilerin başarı, motivasyon ve bilgisayar kaygı düzeyleri [Students' achievement, motivation and computer anxiety level in different web based learning environments]. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi (HU: Journal of Education), 34*(34), 140-154. http://www.efdergi.hacettepe.edu.tr/shw_artcl-534.html

Karakaya, F., Aycjn, U̇. N. A. L., Cjmen, O., & Yılmaz, M. (2018). STEM awareness levels of science teachers. *Journal of Research in Education and Society,* 5(1), 124-138. https://dergipark.org.tr/en/pub/etad/issue/37928/379114

Kızılay, E. (2018). Career and employment in STEM fields in Turkey. The Journal of International Social Research, 11(6), 570-574. http://dx.doi.org/10.17719/jisr.20185639031

Kier, M. W., Blanchard, M. R., Osborne, J. W. & Albert, J. L. (2014). The development off the STEM career interest survey (STEM-CIS). Research in Science Education, 44(3), 461-481. doi:10.1007/s11165-013-9389-3

Koyunlu Unlu, Z., Dokme, I., & Unlu, V. (2016). Adaptation of the science, technology, engineering, and mathematics career interest survey (STEM-CIS) into Turkish. *Eurasian Journal of Educational Research*, 63, 21-36, http://dx.doi.org/10.14689/ejer.2016.63.2

Koszalka, T. (1999). The relationship between the types of resources used in science classrooms and middle school students' interest in science careers: an exploratory, (Unpublished doctoral dissertation), The Pennsylvania State University. https://mltei.tripod.com/files/aect2000_careerinterest_proceedings.pdf

Kuzgun, Y. (2003). Introduction to vocational guidance and counseling. Ankara: Nobel Yayın Dağıtım.

Markowıtz, D. G.(2004). Evaluation of the long-term impact of a university high school summer science program on students' interest and perceived abilities in science, *Journal of Science Education and Technology*, 13, 395-407. https://doi.org/10.1023/B:JOST.0000045467.67907.7b

Marulcu, İ., Saylan, A. & Güven, E. (2014). Evaluation of the little scientists' science school which was organized for 6th and 7th graders. *Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi*,11(25),341-352. http://dergipark.org.tr/mkusbed/issue/19562/208454

MoNE (Turkish Ministry of National Education) (2018) *Science and technology curriculum for elementary science*. http://ttkb.meb.gov.tr/ogretmen/index.php

Muro, J., & Kottman, T. (1995). *Guidance and Counselling in the Elementary and Middle Schools*. Dubuque, IA: Brown and Benchmark.

Murphy, C., & Beggs, J. (2005). Coteaching as an approach to enhance science learning and teaching in primary schools. Counterpoints, 294, 207–231. https://www.jstor.org/stable/42978839

National Research Council (2012). *A framework for k-12 science education: practices, crosscutting concepts, and core ideas*. Washington, DC: The National Academies Press. https://doi.org/10.17226/13165.

National Research Council (2015). *Enhancing the effectiveness of team science*. Washington, DC: The National Academies Press. https://doi.org/10.17226/19007.

Organization for Economic Cooperation and Development (OECD) (2007). PISA 2006 Science Competencies for Tomorrow's World, Volume 1: Analysis. Paris: OECD. https://www.oecd.org/unitedstates/39722597.pdf

PCAST (2010) Prepare and inspıre: k-12 education in scıence, technology, engineering, and math (stem) for amerıca's future, President's Council of Advisors on Science and Technology http://www.whitehouse.gov/ostp/pcast

Schnittka, C. G., Evans, M. A., Won, S., & Drape, T. D. (2015). Looking for learning in afterschool spaces: Studio STEM. Research in Science Education. https://doi.org/10.1007/ s11165-015-9463-0

Sezen Vekli, G. (2013). Summer science camp for middle school students: a Turkish experience, Asia-Pasific Forum on Science Learning and Teaching,14(1). https://www.eduhk.hk/apfslt/download/v14_issue1_files/vekli.pdf

Super DE. 1984. Leisure: What it is and might be. *Journal of Career Development*. 11(2):71-80. https://doi.org/10.1177/089484538401100203

Şahin, A., Ayar, M. C. & Adıgüzel, T. (2014). STEM related after-school program activities and associated outcomes on student learning. *Educational Science: Theory & Practice*, 14(1),309-322. https://doi.org 10.12738/estp.2014.1.1876

STEM Education Coalition. (2016). 2016 Annual Report. Available from: http://www.stemedcoalition.org/wp-content/uploads/2016/01/2016-Annual-Report-Final.pdf.

Ralston, P. A., Hieb, J. L., & Rivoli, G. (2012). Partnerships and experience in building STEM pipelines. Journal of Professional Issues in Engineering Education and Practice, 139(2), 156-162. https://doi.org/10.1061/(ASCE)EI.1943-5541.0000138

Tai, R., Liu, C., Maltese, A., & Fan, X. (2006). Planning early for careers in science. Science, 312(5777), 1143–1144. DOI:10.1126/science.1128690

Tekbıyık, A., Şeyihoğlu, A., Sezen Vekli, G. & Birinci Konur, K. (2013). Influence of a science camp based on active learning on students . The Journal of Academic Social Science Studies, 6(1), 1383-1406. https://doi.org 10.9761/jasss_545

Uğraş, M. (2019). Middle school students' interest in science- technology-engineering and mathematics (stem) career. Turkish Studies Volume 14 ıssue 1,2019, p. 751-774 https://doi.org:10.7827/turkishstudies.14

Yıldırım, M., Atila, M., & Doğar, Ç. (2016). Views of 6th and 7th grades students towards sciences activities in the project of "little scientists in discovery. YYU Journal Of Education Faculty , 13(1), 194-212. http://dergipark.org.tr/yyuefd/issue/25853/2725